

TWO NEW SPECIES OF PROTURA (INSECTA) FROM NORTH AMERICA

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Abstract.—*Eosentomon adakense*, n. sp. (Eosentomidae) from the Aleutian Islands and *Neocondeellum americanum*, n. sp. (Protentomidae) from Tennessee are described and figured. *Eosentomon adakense* differs from other *Eosentomon* species by the possession of long middle and hind empodia, sensillum b'1, labral setae, and six setae on sternites IX and X. A key to *Eosentomon* species with long hind empodia is given. *Neocondeellum americanum* differs from all other *Neocondeellum* species by the possession of two minute sensilla on the foretarsus in addition to the normal five.

This paper contains the descriptions of two species of Protura, one from Adak Island in the Aleutian chain and the other from eastern Tennessee. The new species of *Neocondeellum* Tuxen and Yin described in this paper represents the first record of the genus from North America.

Methods

Specimens were collected by a sugar flotation-centrifugation method (Jenkins 1964) and preserved in 95% ethanol, then mounted in polyvinyl alcohol-lactophenol and dried in a 60°C oven to expand and clear the bodies. Terminology used in this paper is largely that of Tuxen (1964). Holotypes and paratypes numbered in the text are deposited in the U.S. National Museum of Natural History.

Eosentomon adakense, new species

Figs. 1, 3-15; Table 1

Color and dimensions.—Body fragile, sclerites yellowish only on the last several abdominal segments. Length of holotype female 836 μm , that of allotype male 759 μm . Length of foretarsus without claw 82 μm in female, 80 μm in male. Length of head without labrum 109 μm in female, 116 μm in male. LR = 12, PR = 9.6 (range = 9.1-10.3); TR = 5.7 (4.9-6.4).

Morphology.—Pseudoculus broadly oval with a weak longitudinal line and a pair of weak, oval depressions in the center (Fig. 11). Clypeal apodeme small but stout, the sides connected only anteriorly. Labrum (Fig. 5) short and inconspicuous, the anterior edge shallowly V-shaped; labral setae present, not extending past anterior edge of labrum. Rostral setae not inflated. Mandible (Fig. 9) with three teeth, two of them terminal and inner tooth subterminal. Galea of maxilla (Fig. 7) broad, with two exterior spines, more anterior one long, rounded median digit bent outward, and two inner digits bent slightly inward. Outer lobe of lacinia short, slightly curved, inner edge smooth; inner lobe slender, strongly curved (Fig. 8). Six outer setae of labium in three groups: one anterior, three in middle, two posteriorly (Fig. 6); anterior tip of labium with few irregular, minute teeth and three weak thickenings.

Table 1.—Chaetotaxy of *Eosentomon adakense* n. sp.

		Formula	Composition
(Dorsal)			
Thorax	I	4	
	II	<u>8</u>	a 1, 2, 3, 4
		14	p 1, 1', 2, 2', 3, 3', 4
	III	<u>10</u>	a 1, 2, 3, 4, 4'
	14	p 1, 1', 2, 2', 3, 3', 4	
Abdomen	I	<u>4</u>	a 1, 2
		10	p 1, 1', 2, 3, 3'
	II-IV	<u>10</u>	a 1, 2, 3, 4, 5
		16	p 1, 1', 2, 2', 3, 4, 4', 5
	V-VI	<u>8</u>	a 1, 2, 4, 5
		16	p 1, 1', 2, 2', 3, 4, 4', 5
	VII	<u>6</u>	a 2, 4, 5
		16	p 1, 1', 2, 2', 3, 4, 4', 5
	VIII	<u>4</u>	a 1, 3
		9	p c, 1, 1', 2, 3
	IX-XI	8	p 1, 2, 3, 4
	XII	9	
(Ventral)			
Thorax	I-II	<u>8</u>	
		6	
	III	<u>10</u>	
	8		
Abdomen	I	<u>4</u>	a 2, 3
		4	p 1, 2
	II-III	<u>6</u>	a 2, 3, 4
		4	p 1, 2
	IV-VII	<u>6</u>	a 2, 3, 4
		10	p 1, 2, 2', 2'', 3
	VIII	<u>2</u>	a 2
		7	p c, 1, 1', 2
	IX-X	6	p 1, 1', 2
	XI	8	p 1, 2, 3, 4
	XII	10	

Empodium of foretarsus nearly as long as claw, EUI = 0.98 (0.9–1.1). Empodia of middle and hind legs well-developed (Figs. 12–13), EUII = 0.59 (0.54–0.63), EUIII = 0.58 (0.58–0.59).

Central lobe of praecosta not indented. Squama genitalis of female (Fig. 15) weakly sclerotized, caput processus nearly straight distally but curving proximally into corpus processus. Median sclerotizations not seen. Filum processus longer than stylus; stylus tip broadly rounded. Male squama genitalis identical to that of other *Eosentomon* species.

Chaetotaxy.—Paired sensilla behind the pseudoculus minute, pyriform (Fig. 10).



Figs. 1-2. *Eosentomon adakense*: 1, Dorsal view of holotype female. *Neocondeellum americanum*: 2, Dorsal view of holotype female. Scales in μm .

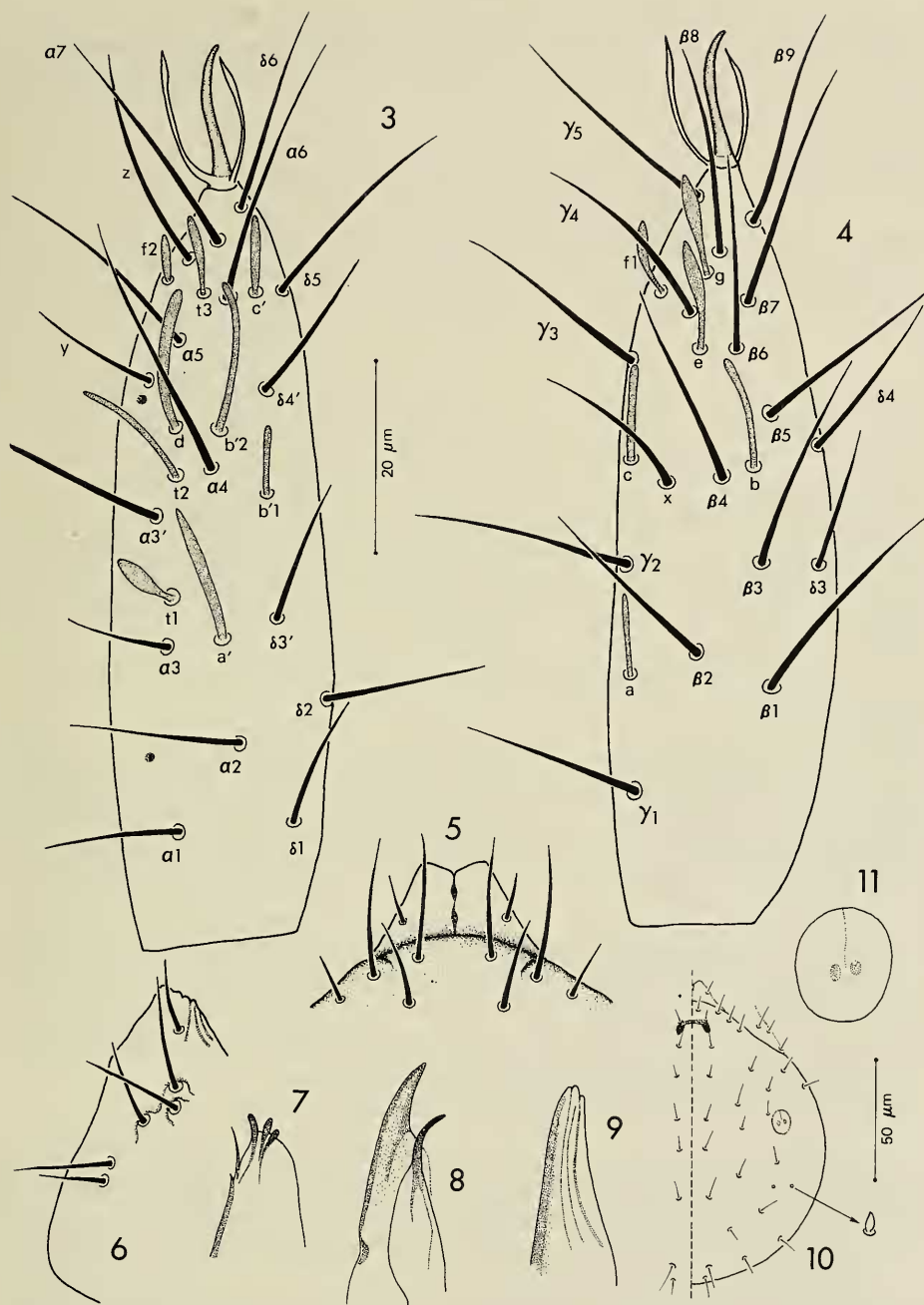
In foretarsus, sensillum *b'1* present; sensillum *a* short and slender, not reaching seta $\gamma 2$; *b* reaching the base of $\beta 6$, *c* reaching $\gamma 3$; *d* broad and long; *f1*, *e*, and *g* spatulate, *f2* short. Sensillum *a'* broad and long; *b'2* about as long as *d* and twice the length of *b'1*; *c'* present, reaching to the base of seta $\delta 6$. Sensillum *t1* closer to $\alpha 3$ than to $\alpha 3'$; BS = 0.86; *t2* slender, *t3* clavate (Figs. 3-4). Foretarsal pits located level with seta $\alpha 2$ and slightly posterior to seta *y*.

Thoracic and abdominal setal compositions as given in Table 1. Accessory setae *p1'* and *p2'* of tergites II-VI nearly twice the length of *p1* and *p2* (Fig. 14).

Collection data.—Holotype female (Type #101410) and allotype male extracted from soil collected by M. P. Williams at Kuluk Bay, Adak Island, Aleutian Islands, Alaska, 13 Aug 1978.

Diagnosis.—*Eosentomon adakense* can be separated from most other *Eosentomon* species by the presence of long hind empodia. From the fifteen previously described species with long hind empodia, *E. adakense* can be differentiated by the following characteristics: sensillum *b'1* present, empodium of middle leg long, labral setae present, sternites IX and X with six setae.

The following key will serve to differentiate those species of *Eosentomon* which have long hind empodia. The key is based primarily on original and revised descriptions from several sources.



Figs. 3-11. *Eosentomon adakense*: 3, Foretarsus, dorsal view; 4, Foretarsus, ventral view; 5, Labrum, dorsal view; 6, Right prelabium, ventral view (palpus not drawn); 7, Left galea of maxilla; 8, Left lacinia of maxilla; 9, Left mandible; 10, Pseudoculus; 11, Right side of head, dorsal view, and enlargement of cephalic sensillum. (50 μm scale applies to Fig. 10, 20 μm scale to all others.)

Table 2.—Chaetotaxy of *Neocondeellum americanum* n. sp.

		Formula	Composition
(Dorsal)			
Thorax	I	4	
	II-III	<u>6</u>	a 1, 2, 3
		14	p 1, 1', 2, 2', 3, 4, 4'
Abdomen	I	<u>4</u>	a 1, 2
		14	p 1, 1', 2, 2', 3, 4, 4'
	II-VI	<u>4</u>	a 1, 2
		14 ¹	p 1, 2, 2', 3, 4, 4', 5
	VII	<u>4</u>	a 1, 5
		18	p 1, 1', 2, 2', 3, 3', 4, 4', 5
	VIII	<u>6</u>	a 1, 3, 5
		12	p 1, 1', 2, 3, 4, 5
	IX	12	p 1, 1', 2, 2', 3, 4
	X	10	p 1, 2, 3, 4, 5
	XI	8	p 1, 2, 3, 4
	XII	9	
(Ventral)			
Thorax	I	10	
	II	12	
	III	14	
Abdomen	I	<u>4</u>	a 1, 2
		4	p 1, 1'
	II-III	<u>4²</u>	a 1, 2
		5	p c, 1, 2
	IV-V	<u>4</u>	a 1, 2
		8	p 1, 1', 2, 3
	VI-VII	<u>4</u>	a 1, 2
		9	p c, 1, 1', 2, 3
	VIII	6	p 1, 1', 2
	IX-X	4	p 1, 2
	XI	6	
	XII	6	

¹ Seta p2 missing on terg. 5, right side, of holotype.

² Holotype with an a c seta on stern. III.

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|----|---|--------------------------------|
| 1. | Sensillum b'1 present | 6 |
| - | Sensillum b'1 absent | 2 |
| 2. | Sensillum t1 closer to seta $\alpha 3$ than to $\alpha 3'$ | 3 |
| - | Sensillum t1 very close to seta $\alpha 3'$ | 5 |
| 3. | Sternite VIII with two anterior setae | 4 |
| - | Sternite VIII without anterior setae | <i>cocqueti</i> Conde |
| 4. | Sternites IX-X with six setae | <i>brevicorpusculum</i> Yin |
| - | Sternites IX-X with four setae | <i>sociale</i> Bernard |
| 5. | Abdominal tergites V and VI with ten anterior setae; sensillum c' well-developed | <i>notiale</i> Tuxen & Imadate |
| - | Abdominal tergites V and VI with eight anterior setae; sensillum c' very short, mammiform | <i>erwini</i> Copeland |

- | | | |
|-----|--|--------------------------------|
| 6. | Sternite VIII with 7 p-setae | 7 |
| – | Sternite VIII with 9 p-setae | <i>novemchaetum</i> Yin |
| 7. | Sensillum e present | 9 |
| – | Sensillum e absent | 8 |
| 8. | Filum processus more than two-thirds length of stylus | <i>meihwa</i> Yin |
| – | Filum processus less than half length of stylus | <i>babai</i> Imadate |
| 9. | Empodium on middle leg more than half length of claw | 10 |
| – | Empodium on middle leg less than half length of claw | 11 |
| 10. | Labral setae present; sternites IX and X with six setae | <i>adakense</i> , n. sp. |
| – | Labral setae absent; sternites IX and X with four setae | <i>saharensense</i> Conde |
| 11. | Labral setae present | 12 |
| – | Labral setae absent | 15 |
| 12. | Sternite VIII with two anterior setae | 13 |
| – | Sternite VIII without anterior setae | <i>pallidum</i> Ewing |
| 13. | Tergite VII with six anterior setae; tergite XI with six setae | |
| | | <i>brassicae</i> Bernard |
| – | Tergite VII with eight anterior setae; tergite XI with eight setae | 14 |
| 14. | Corpus processus strongly sclerotized, slender | <i>pruni</i> Bernard |
| – | Corpus processus weakly sclerotized, broad | <i>pinusbanksianae</i> Bernard |
| 15. | Sensillum f1 twice as long as f2; sternites IX–X with six setae | |
| | | <i>udagawai</i> Imadate |
| – | Sensilla f1 and f2 of equal length; sternites IX–X with four setae | |
| | | <i>simile</i> Conde |

Imadate (1974) examined several Chinese *Eosentomon* species described by Yin (1965) and determined that some possessed long hind empodia. These are included in the key above, with the exception of *E. orientalis* Yin. Imadate could find no differences between *E. orientalis* and *E. udagawai* Imadate, 1961, and was inclined to consider them synonyms. Thus *E. orientalis* is not included in the key.

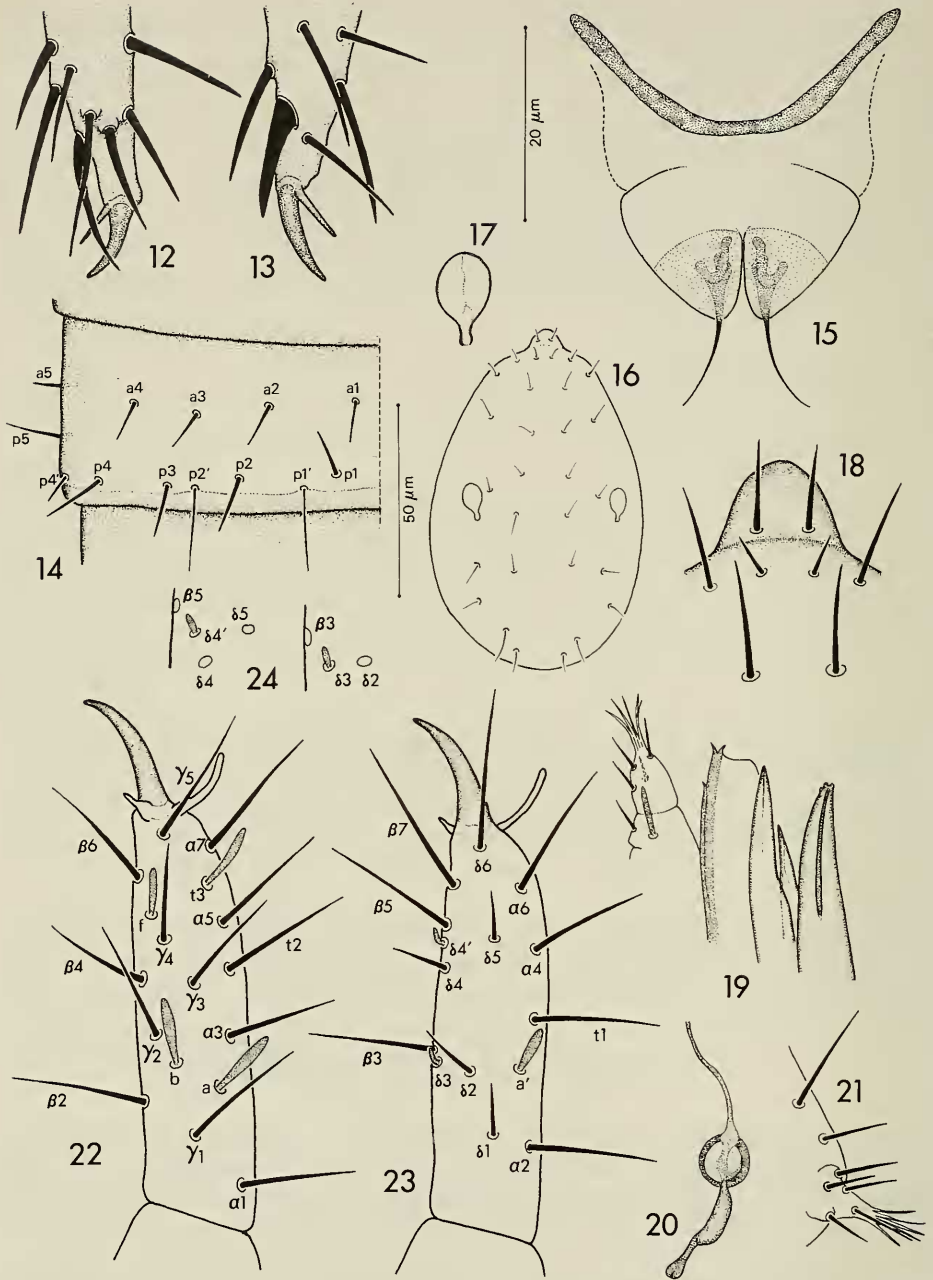
Bernard (1975) described *E. pinusbanksianum* from Michigan. Dr. George C. Steyskal (in litt., 29 Oct 1976) pointed out that the specific name was incorrectly formed and needed alteration. It is therefore emended to *E. pinusbanksianae*.

Neocondeillum americanum, new species

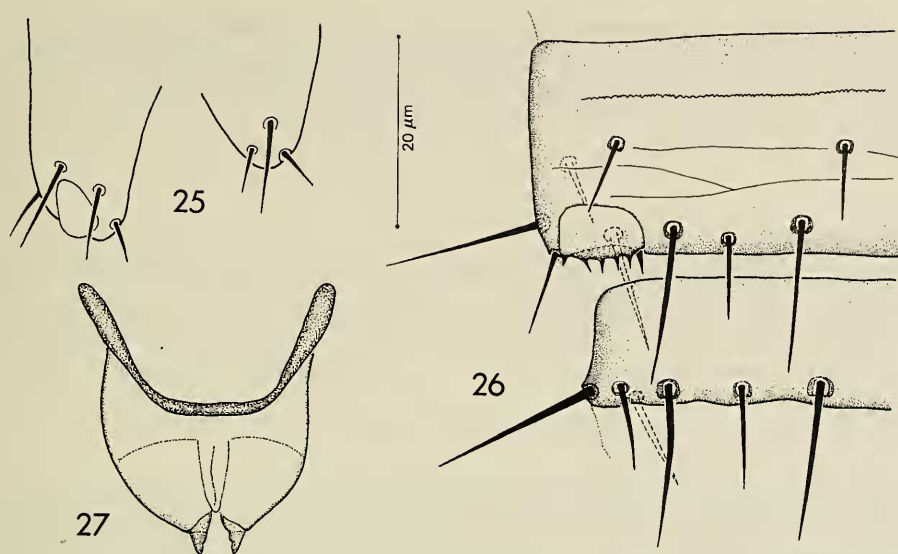
Figs. 2, 16–27; Table 2

Color and dimensions.—Body slender, sclerotization prominent only on the last five abdominal segments. Length of holotype female 787 μm , that of two paratype females 784 μm (range = 771–798 μm). Length of foretarsus without claw 42 μm for all females; length of head without labrum 83 μm for females. LR = 19; PR = 10.0, TR = 3.0.

Morphology.—Pseudoculus oval with posterior prolongation about one-third its length, median line very weak (Fig. 17). Labrum very short, rounded (Figs. 16–17), with one pair of setae. Mandible with 3 minute, rounded teeth, 2 terminal and 1 subterminal, and prominent median groove (Fig. 19); lobes of lacinia straight and stout anteriorly, bluntly pointed; galea broad, thickened only along outer edge, with two diverging, pointed lobes terminally and third, minute, pointed lobe on exterior edge. Maxillary palpus with only 1 sensillum-like seta. Labial



Figs. 12-24. *Eosentomon adakense*: 12, Middle tarsus; 13, Hind tarsus; 14, Tergite VI, left side, 15, Female squama genitalis. *Neocondeellum americanum*: 16, Head, dorsal view; 17, Pseudoculus; 18, Labrum; 19, Mouthparts of left side (left to right: maxillary palpus, galea, lacinia, mandible); 20, Canal of maxillary gland, proximal portion; 21, Labial palpus; 22, Foretarsus, exterior view; 23, Foretarsus, interior view; 24, Arrangements of minute foretarsal sensilla on a paratype. (50 μm scale applies to Fig. 16, 20 μm scale to all others.)



Figs. 25–27. *Neocondeellum americanum*: 25, Appendages of first and third abdominal segments; 26, Tergites VIII–IX, left side; 27, Female squama genitalis.

palpus with terminal tuft of seta-like lobes and 5 other setae (Fig. 21). Canal of maxillary gland similar to that of other members of genus, posterior portion swollen for more than half its length then narrowed to slightly enlarged terminus; calyx round (Fig. 20).

Empodium of foretarsus short, about one-sixth length of claw; middle and hind legs similar to those of other *Neocondeellum* species. Appendages of first abdominal segment with 4 setae, those of second and third segments with 3 setae each (Fig. 25). Upper edge of gland cover on tergite VIII with 5 teeth; lower edge smooth except for 1 tooth on interior corner (Fig. 26). Female squama genitalis with enlarged arms on basal apodeme; acrostylus conoid, with narrowly rounded tip and 1 or 2 indentations on interior surface (Fig. 27).

Males not seen.

Chaetotaxy.—Head with 4 setae between pseudoculi (Fig. 16).

Foretarsus characterized by presence of 2 minute sensilla ventrally, one apparently reduced, modified $\delta 3$, the other a doubled $\delta 4$ and thus labeled $\delta 4'$ (Figs. 23–24); these 2 sensilla appearing bent in profile on holotype (Fig. 23), but appearing peg-like when seen less obliquely on paratype (Fig. 24). Sensilla *a*, *b*, and *t3* of equal length and longer than *a'* and *f* (Figs. 23–24).

Thoracic and abdominal compositions as given in Table 2. Tergite VIII with 3 anterior and 6 posterior setae on each side; tergite IX with 6 setae on each side (Fig. 26).

Collection data.—Holotype female (Type #101411) and one paratype female extracted from soil collected under turf and yellowwood trees (*Cladrastis lutea* (Michx.) K. Koch) on the west side of the Plant Sciences Building, University of Tennessee, Knoxville, 24 Feb 1984; and one paratype female collected from the same locality 15 Feb 1978.

Diagnosis.—*Neocondeellum americanum* differs from the other four species of the genus (Tuxen and Yin 1982) by the sensillar nature of seta $\delta 3$ and the presence of an extra sensillum here designated $\delta 4'$. Additionally, the maxillary sensilla of *N. americanum* consist of one typical sensillum and a setiform sensillum, a dichotomy shared only with *N. matobai* (Imadate, 1973; see Tuxen and Yin 1982).

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